2016. Journal of Arachnology 44:83–84

SHORT COMMUNICATION

Black bears feed on harvestmen (Opiliones) in northwestern Mexico

Robert W. Jones[1], **Carlos López-González**[1], **Cora Varas**[2] and **Lizbeth Gaona-Escamilla**[3]: [1]Facultad de Ciencias Naturales, Universidad Autónoma de Querétaro, C.P. 76230, Juriquilla, Querétaro, México. E-mail: rjones@uaq.mx; [2]Genetics Graduate Interdisciplinary Program. University of Arizona, Tucson, AZ 85721; [3]Facultad de Biología, Universidad Michoacana de San Nicolás de Hidalgo, C.P. 58030 Morelia, Michoacán, México

Abstract. We report on the feeding by black bears on harvestmen (Opiliones). Two scats of black bears from Sonora, Mexico each had over 50 bodies of a species of *Leiobunum* C.L. Koch, 1839 collected in localities separated by 5 km. Microsatellite analysis indicated that the scats were from different individuals. That all harvestmen were found in only two of the 180 scats sampled suggested that the two bears fed on harvestmen while in aggregations. Because black bears are probably minimally affected by defensive compounds and would presumably not actively search for individual harvestmen, black bear predation on harvestmen, if frequent enough, would be a factor selecting against aggregative behavior in these arachnids in the study area. Further research is needed on the aggregation behavior and other natural enemies of harvestmen in northwestern Mexico.

Keywords: Opiliones, predation, black bears, Mexico

Harvestmen (Opiliones) are a well-known order of Arachnida found in almost all terrestrial ecosystems. Although generally not considered a numerically dominant taxon within the arthropods, Opiliones are relatively common and can have diverse communities, especially in tropical habitats (Proud et al. 2012), as well as having many and complex interactions with other organisms (Cokendolpher & Mitov 2007). Of these, the predators of harvestmen include many reported arthropods and vertebrates comprising many bird species, reptiles and small to medium sized (< 20 kg) mammals (Cokendolpher & Mitov 2007).

In the present paper, we report on the predation of aggregations of harvestmen by black bears (*Ursus americanus*). This finding was first made during a study of the population genetics and ecology of black bears in the state of Sonora in northwestern Mexico, and was previously cited in a list of prey items (Sierra Corona et al. 2005), although no mention or discussion of Opiliones was included in the text. The study site is one of the southernmost populations of this large carnivore, located within the "El Pinito" Ranch in the Sierra de San Luis, Sonora, Mexico, with the northwestern corner located at 31.20° N and 109.94° W and the southeastern corner at 31.12° N and 108.82° W. Sampling was carried out during April–November of 2002. A grid of camera traps was established to identify and determine population structure and density of black bears, and scats were collected and analyzed. Scats were used to determine feeding habits, as well as provide genetic sequences to identify individuals. These genetic sequences were obtained by amplifying and sequencing 10 microsatellites previously used for black bears (G10B, G10H, G10L, G10M, G1A, G10J, G1D, G10O, CXX20, and G10X). The software program Cervus 3.0 (Marshall et al. 1998) was used to determine individual identity, attributing the same individual identification only to scats with identical alleles. All samples of Opiliones are stored as vouchers in the Zoological Collection of the Facultad de Ciencias Naturales, Universidad Autónoma de Querétaro, Querétaro, Mexico.

Two of a total of 180 black bear scats were found with fragments of harvestmen: the first with 62 bodies (prosoma + opistosoma, without legs) on 2 July 2002, and the second with 123 bodies on 10 July 2002. All bodies were identified as a single species of *Leiobunum* C.L. Koch, 1839 based on the key by Morales (1980) and through comparisons with species descriptions (Goodnight & Goodnight 1942, 1945, 1946, 1947). A species determination was impossible to make due both to how distorted the body parts were (Fig. 1) and to the lack of keys for this speciose genus in northern Mexico. Both scats were found in oak-pine vegetation and were separated by 5 km. Analysis of microsatellites from the scats indicated that they were from different individuals. Varas (2010) determined that the population of black bears at the study site was composed of a minimum of 33 individuals at the time of the study.

That all fragments were concentrated in two scats suggests that both black bear individuals fed on aggregations of this *Leiobunum* species. Aggregation of harvestmen is common for many species and has been reported for 10 species of the genus *Leiobunum* (Cokendolpher 1988; Machado & Macías-Ordóñez 2007). Within the study site, large aggregations were frequently observed along dry river canyons. It is unknown whether bears eat harvestmen only as the result of chance encounters with aggregations or whether bears initiate active, directed searches for the aggregations under certain conditions.

Of the many hypotheses to explain why harvestmen aggregate, improved defense against natural enemies is frequently proposed. Machado & Macías-Ordoñez (2007) group the defensive hypotheses into three categories based on the possible differences in predation rates of individuals alone or in aggregation. These include: 1) increased concentrations of scent gland defensive secretions in aggregations, 2) augmentation of escape capabilities aided by alarm signals communicated within aggregations, and 3) reduced probabilities of being encountered by a predator due to dilution effects of aggregations when compared to more dispersed populations. Given the large size of black bears and the lack of adaptations to capture small prey, the cost-benefit ratio for bears feeding on individual harvestmen is almost certainly not favorable. Feeding on large aggregations however may result in a net gain of energy and/or nutrients relative to the energy expended. As for defensive compounds, those of Opiliones probably have little effect on such a large carnivore given the variety of other arthropods with noxious chemical defenses that are reported as food items (Rodriguez-Martínez et al. 2008; Lopez-Gonzalez et al. 2009). These arguments suggest that predation by black bears on Opiliones in northern Sonora would be a factor selecting for non-aggregative behavior in harvestmen if the rate of bear predation is not balanced by other factors favoring aggregation. More studies are needed to investigate the densities of harvestmen in the study region, the periods and locations

Figure 1.—Fragments of *Leiobunum* sp. from a scat of black bear (*Ursus americanus*) from Sonora, Mexico.

of aggregative behavior, and the frequency of predation on aggregated Opiliones by black bears.

LITERATURE CITED

Cokendolpher, J.C. 1988. Notes on aggregations of *Leiobunum* (Opiliones) in the southern U.S.A. Journal of Arachnology 16:123–126.

Cokendolpher, J.C. & P.G. Mitov. 2007. Natural enemies. Pp. 339–373. *In* Harvestmen: The Biology of Opiliones. (R. Pinto-da-Rocha, G. Machado & G. Giribet, eds.). Harvard University Press, Cambridge, Massachusetts.

Goodnight, C.J. & M.L. Goodnight. 1942. Phalangida from Mexico. American Museum Novitates 1211:1–18

Goodnight, C.J. & M.L. Goodnight. 1945. Additional Phalangida from Mexico. American Museum Novitates 1281:1–17.

Goodnight, C.J. & M.L. Goodnight. 1946. Additional studies of the phalangid fauna of Mexico. American Museum Novitates 1310:1–17.

Goodnight, C.J. & M.L. Goodnight. 1947. Phalangida from Tropical America. Fieldiana: Zoology 32:1–59.

López-González, C., R.W. Jones, C. Silva-Hurtado & I.A. Sáyago-Vázquez. 2009. Scorpions are a food item of black bears in Sonora, Mexico. Western North American Naturalist 69:131–133.

Machado, G. & R. Macías-Ordóñez. 2007. Social behavior. Pp. 400–413. *In* Harvestmen: The Biology of Opiliones. (R. Pinto-da-Rocha, G. Machado & G. Giribet, eds.). Harvard University Press, Cambridge, Massachusetts.

Marshall, T.C., J. Slate, L.E.B. Kruuk & J.M. Pemberton. 1998. Statistical confidence for likelihood-based paternity inference in natural populations. Molecular Ecology 7:639–655.

Morales, S.M., 1980. Contribución al conocimiento de los opiliones de la Republica Mexicana (Arachnida: Phalangida). Tesis de Licenciatura. Facultad de Biologia. Universidad Nacional Autonoma de México, Mexico.

Proud, D.N., B.E. Felgenhauer, V.R. Townsend Jr., D.O. Osula, W. O. Gilmore III, Z.L. Napier et al.. 2012. Diversity and habitat of neotropical harvestmen (Arachnida: Opiliones) in a Costa Rican rainforest. ISRN Zoology, vol. 2012, Article ID 549765, 16 pp. doi:10.5402/2012/549765.

Rodriguez-Martínez, A., C.N. Moreno-Arzate, R. González-Sierra & C.A. López-Gonzalez. 2008. Uso de hábitat, hábitos alimentarios y estructura poblacional del oso negro (*Ursus americanus*) en la Sierra Madre Occidental de México. Pp. 279–294. *In* Avances en el Estudio de los Mamíferos de México II. (C. Lorezo, E. Espinoza & J. Ortega, eds.). Asociación Mexicana de Mastozoología, Departamento de Ecología y Sistemática Terrestre, El Colegio de la Frontera Sur, San Cristóbal de las Casas, Chiapas, México.

Sierra Corona, R., I. A. Sáyago Vázquez, M.C. Silva Hurtado & C.A. López González. 2005. Black bear abundance, habitat use, and food habits in the Sierra San Luis, Sonora. Pp. 444–448. *In* Connecting Mountain Islands and Desert Seas: Biodiversity and Management of the Madrean Archipelago II. (G.J. Gottfried, B.S. Gebow, L.G. Eskew, C.B. Edminster, eds.). Proc. RMRS–P–36. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Varas, A.C. 2010. Conservation genetics of black bears in Arizona and Northern México. Ph.D. Thesis. University of Arizona, Tucson, AZ.

Manuscript received 19 May 2015, revised 13 December 2015.